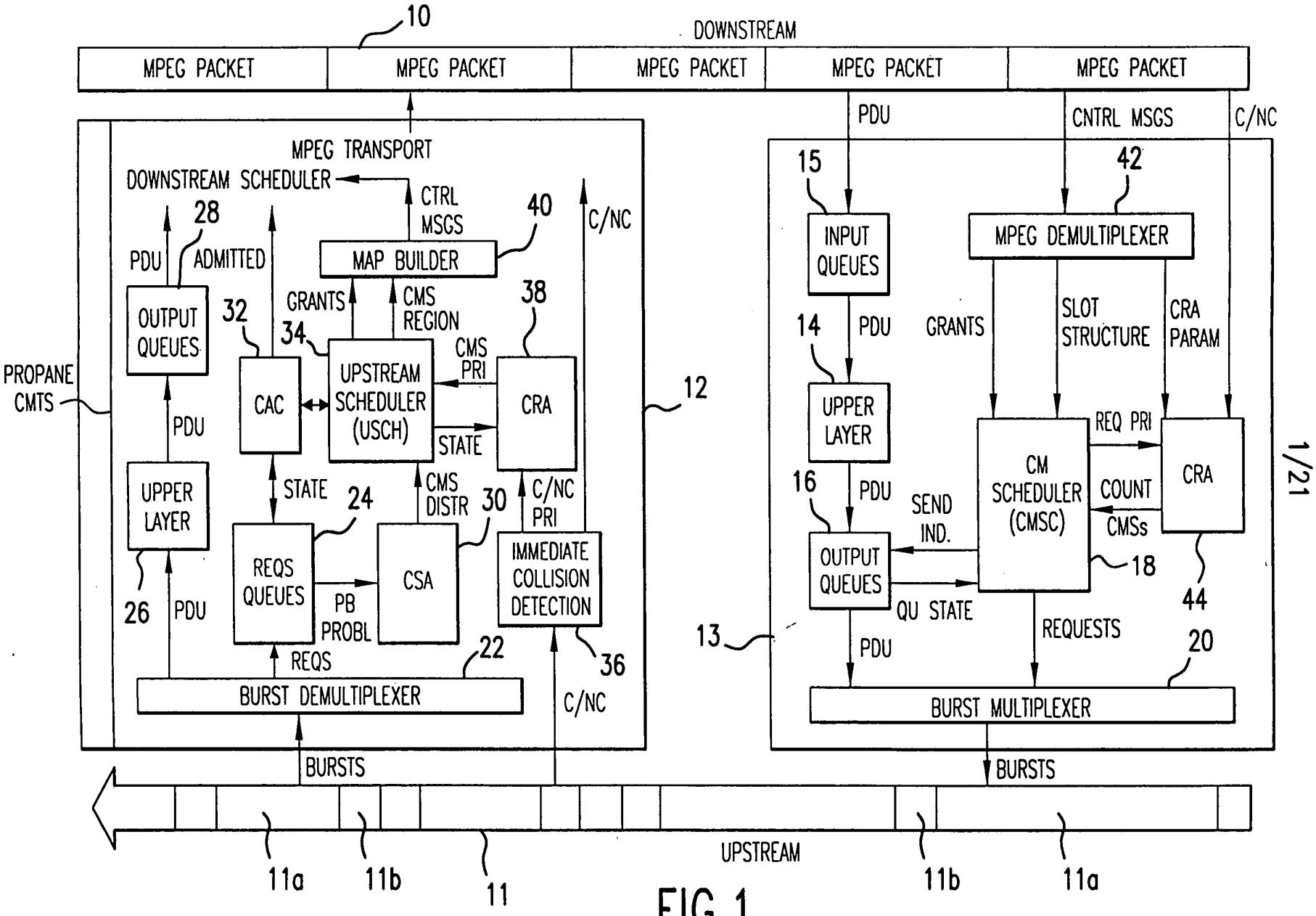
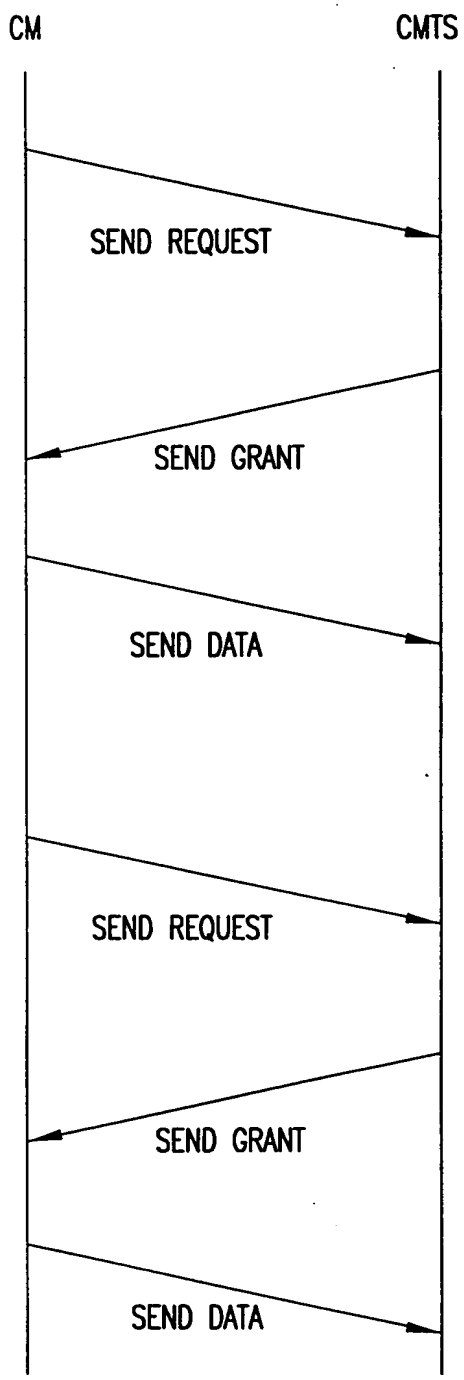
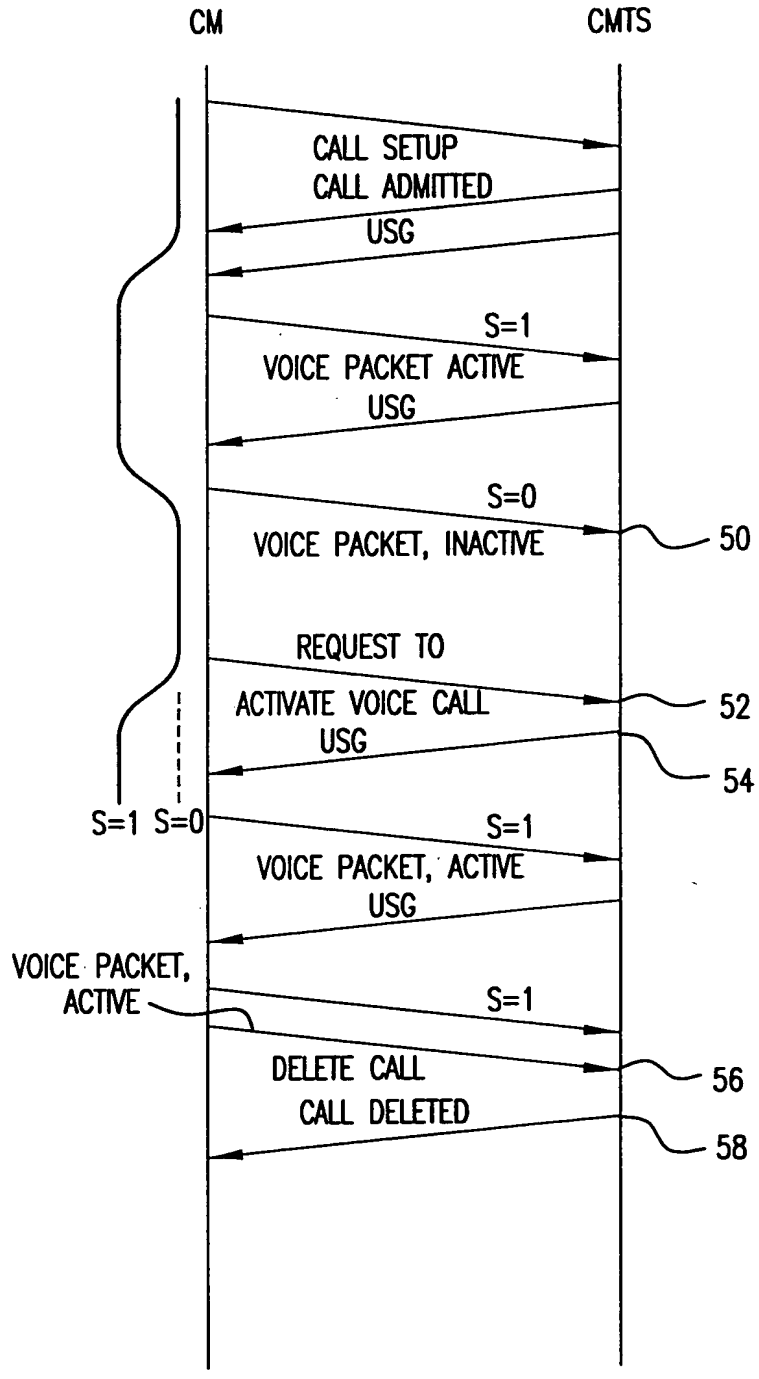

10
DOWNSTREAM
MPEG PACKET
MPEG PACKET
MPEG PACKET
MPEG PACKET
MPEG PACKET
PDU
CNTRL MSGS
C/NC
MPEG TRANSPORT
DOWNSTREAM SCHEDULER
CTRL MSGS
C/NC
15
42
INPUT QUEUES
MPEG DEMULTIPLEXER
28
PDU
ADMITTED
40
MAP BUILDER
OUTPUT QUEUES
32
GRANTS
CMS REGION
34
38
14
PDU
GRANTS
SLOT STRUCTURE
CRA PARAM
PROPANE CMTS
CAC
UPSTREAM SCHEDULER (USCH)
CMS PRI
CRA
12
UPPER LAYER
REQ PRI
PDU
STATE
STATE
CMS DISTR
24
30
C/NC PRI
16
PDU
SEND IND.
CM SCHEDULER (CMSC)
COUNT
CRA
CMSs
REQS QUEUES
CSA
IMMEDIATE COLLISION DETECTION
18
44
OUTPUT QUEUES
26
PDU
PB PROBL
QU STATE
REQUESTS
13
PDU
20
22
36
REQS
BURST DEMULTIPLEXER
C/NC
BURST MULTIPLEXER
BURSTS
BURSTS
UPSTREAM
11a
11b
11
11b
11a

FIG.1



DATA SERVICE

FIG.2A



VOICE SERVICE

FIG.2B

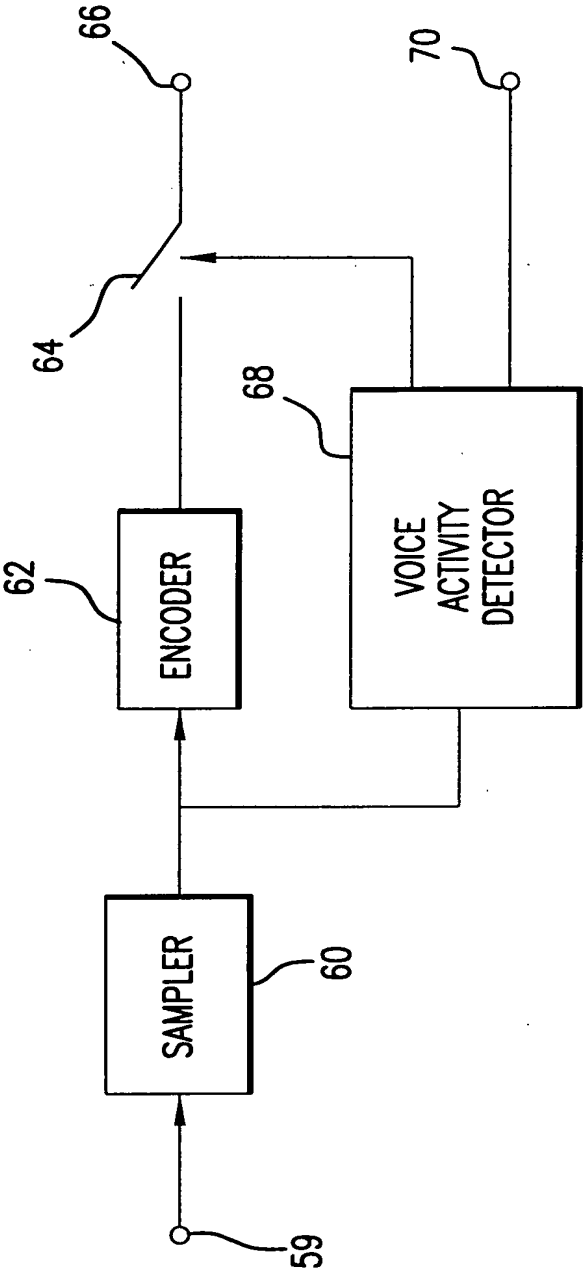


FIG.3

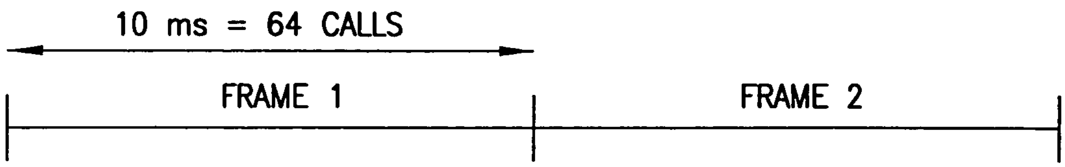


FIG.4A

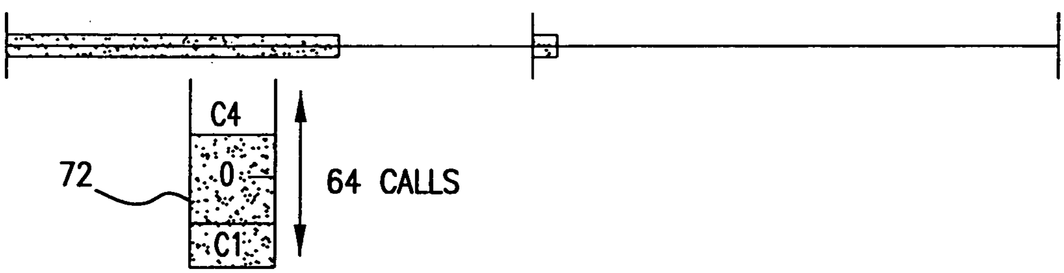


FIG.4B

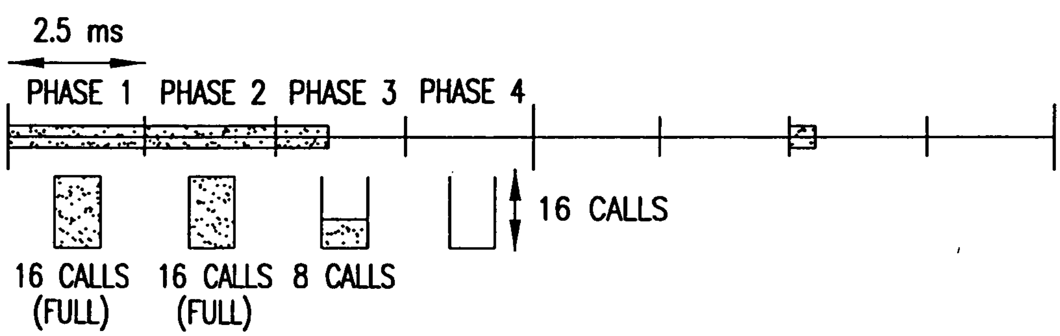


FIG.4C

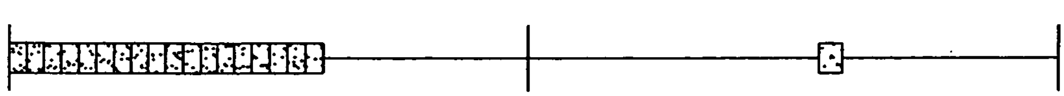


FIG.4D

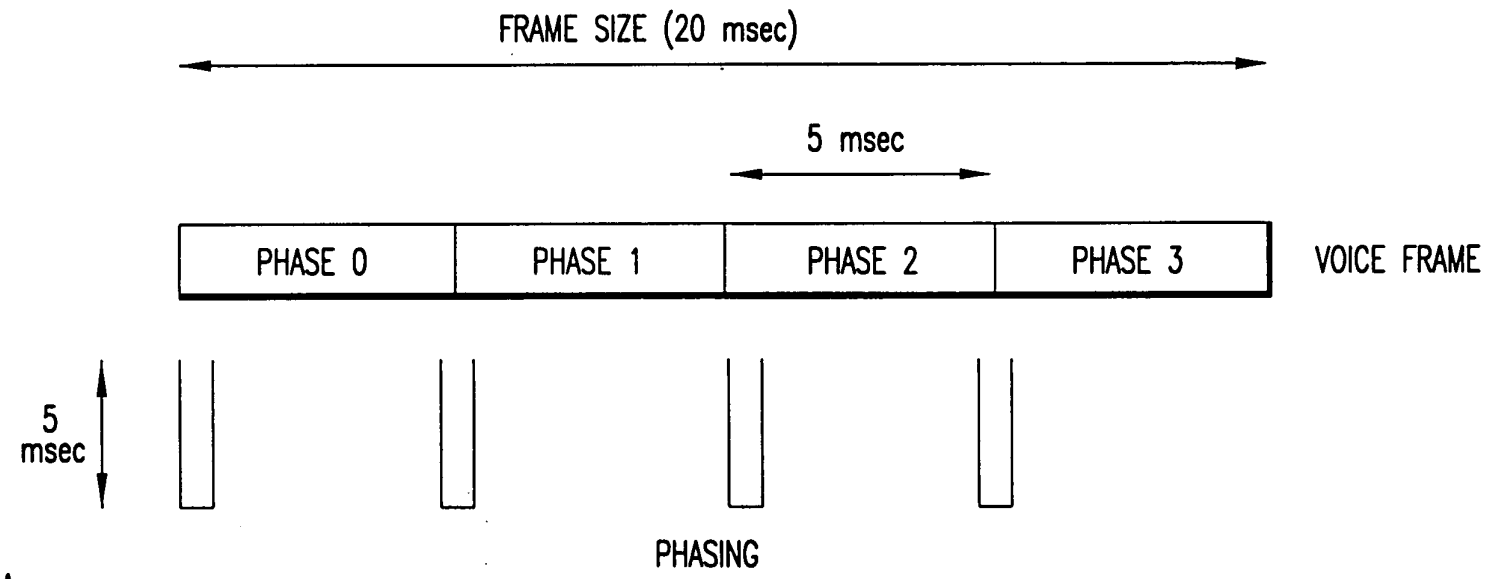

FRAME SIZE (20 msec)
5 msec
PHASE 0
PHASE 1
PHASE 2
PHASE 3
VOICE FRAME
5
msec
PHASING

FIG.5A

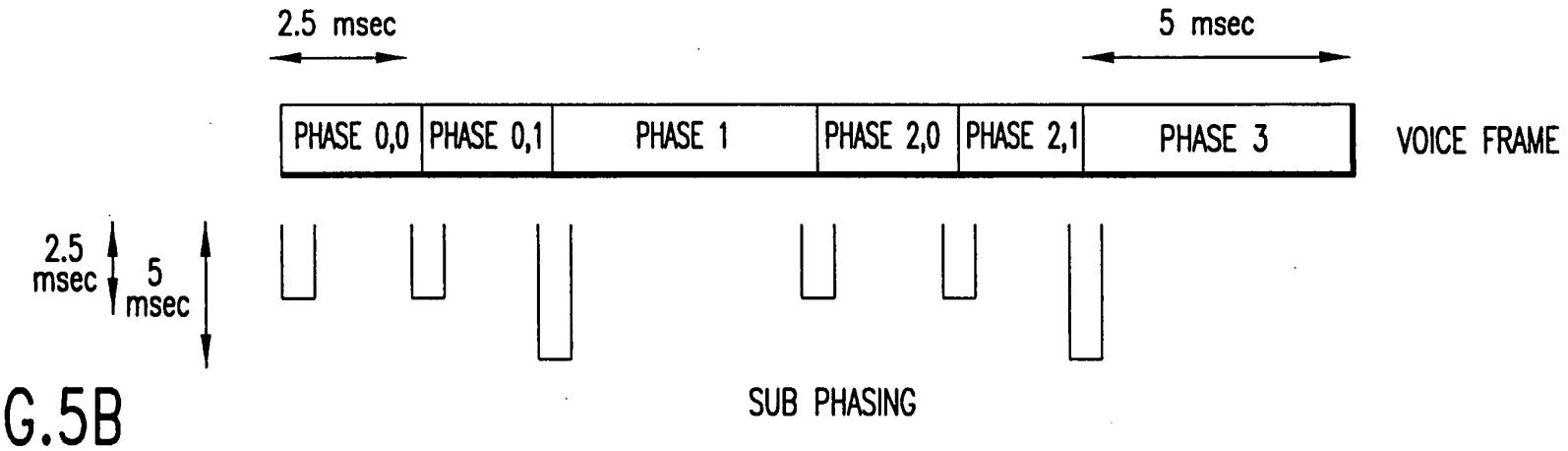
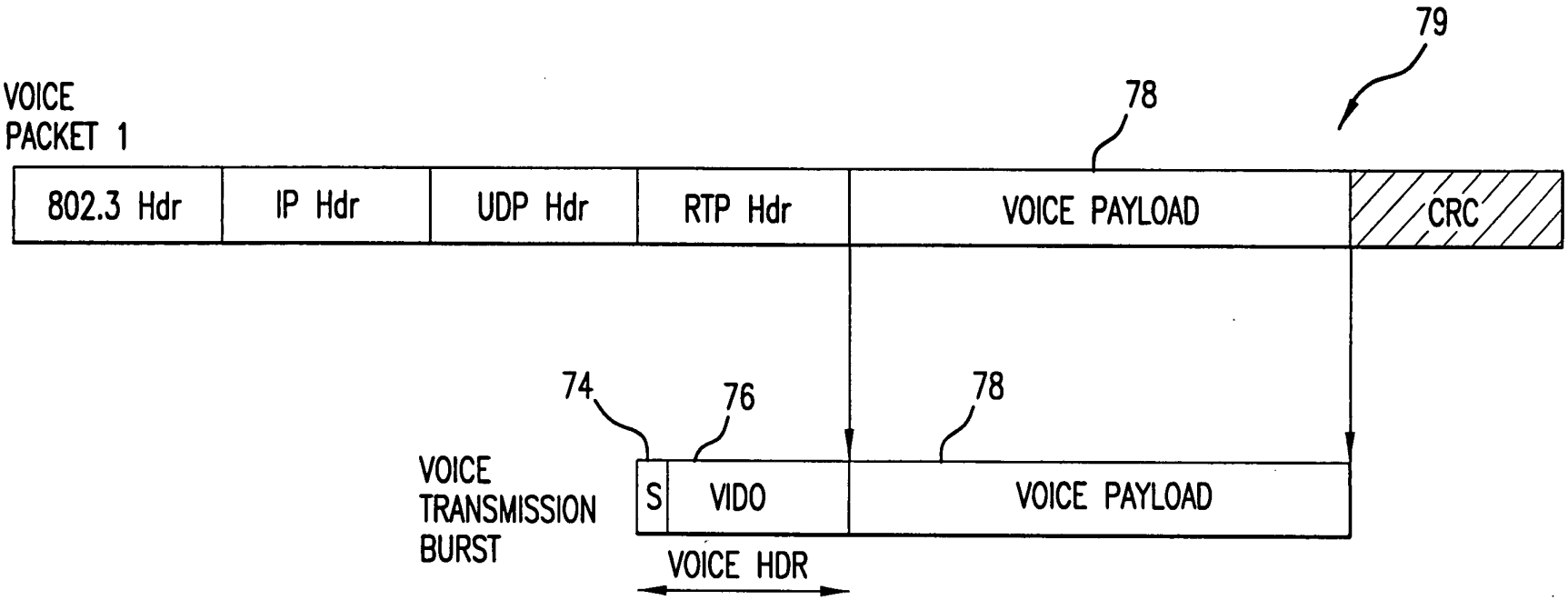

2.5 msec
5 msec
PHASE 0,0
PHASE 0,1
PHASE 1
PHASE 2,0
PHASE 2,1
PHASE 3
VOICE FRAME
2.5
msec
5
msec
SUB PHASING

FIG.5B

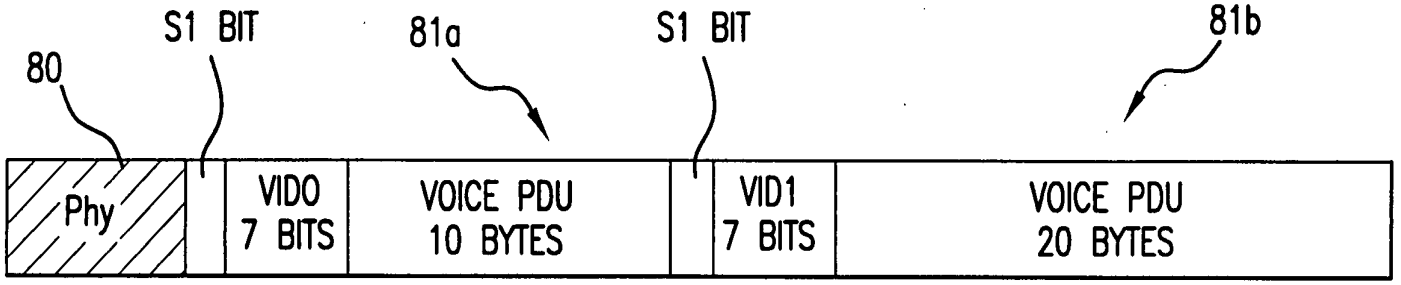
CALL 1: CM1, VIDO: 5ms, 16 Kbps=2 MS (1:0)
CALL 2: CM2, VIDO: 10ms, 32 Kbps=4 MS (2:0)
CALL 3: CM3, VIDO: 20ms, 32 Kbps=7 MS (3:0)
CALL 4: CM4, VIDO: 20ms, 32 Kbps=7 MS (4:0)
CALL 5: CM1, VID1: 10ms, 16 Kbps=3 MS (1:1)
CALL 6: CM2, VID1: 10ms, 16 Kbps=3 MS (2:1)

FIG.5C



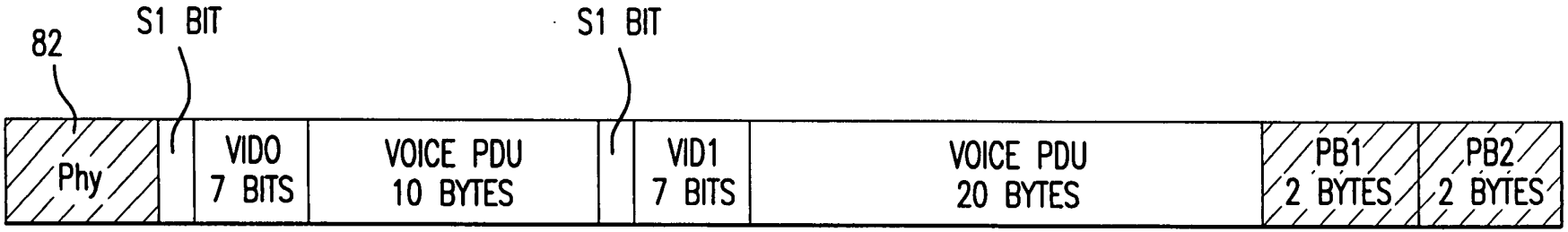
MAPPING VoIP PACKETS INTO VOICE PDUs

FIG.6A



CONCATENATION OF TWO VOICE CHANNELS OF DIFFERENT RATES

FIG.6B



CONCATENATION OF VOICE CHANNELS AND PIGGYBACKING REQUESTS

FIG.6C

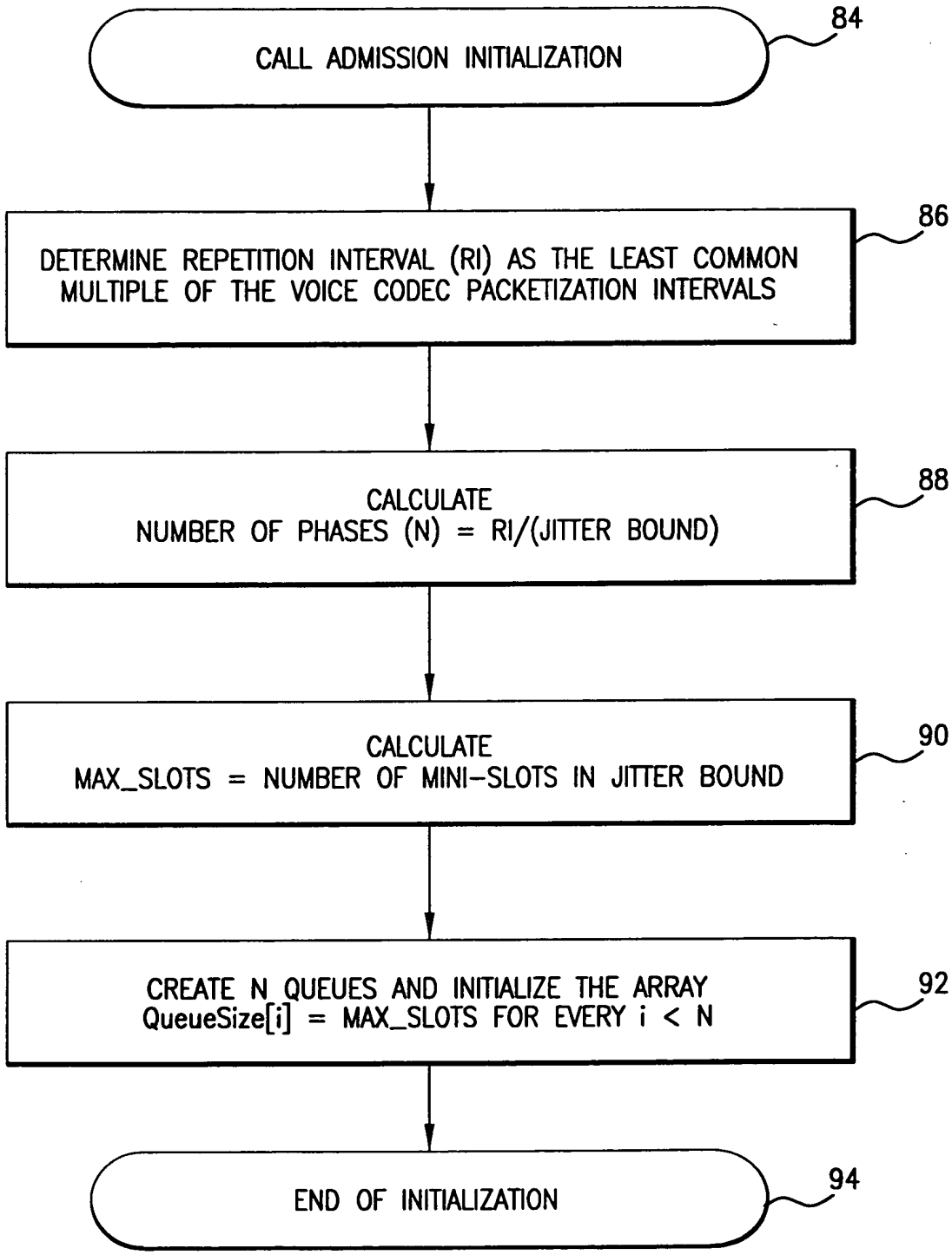

CALL ADMISSION INITIALIZATION
84
DETERMINE REPETITION INTERVAL (RI) AS THE LEAST COMMON MULTIPLE OF THE VOICE CODEC PACKETIZATION INTERVALS
86
CALCULATE
NUMBER OF PHASES (N) = RI/(JITTER BOUND)
88
CALCULATE
MAX_SLOTS = NUMBER OF MINI-SLOTS IN JITTER BOUND
90
CREATE N QUEUES AND INITIALIZE THE ARRAY
QueueSize[i] = MAX_SLOTS FOR EVERY i < N
92
END OF INITIALIZATION
94

FIG.7

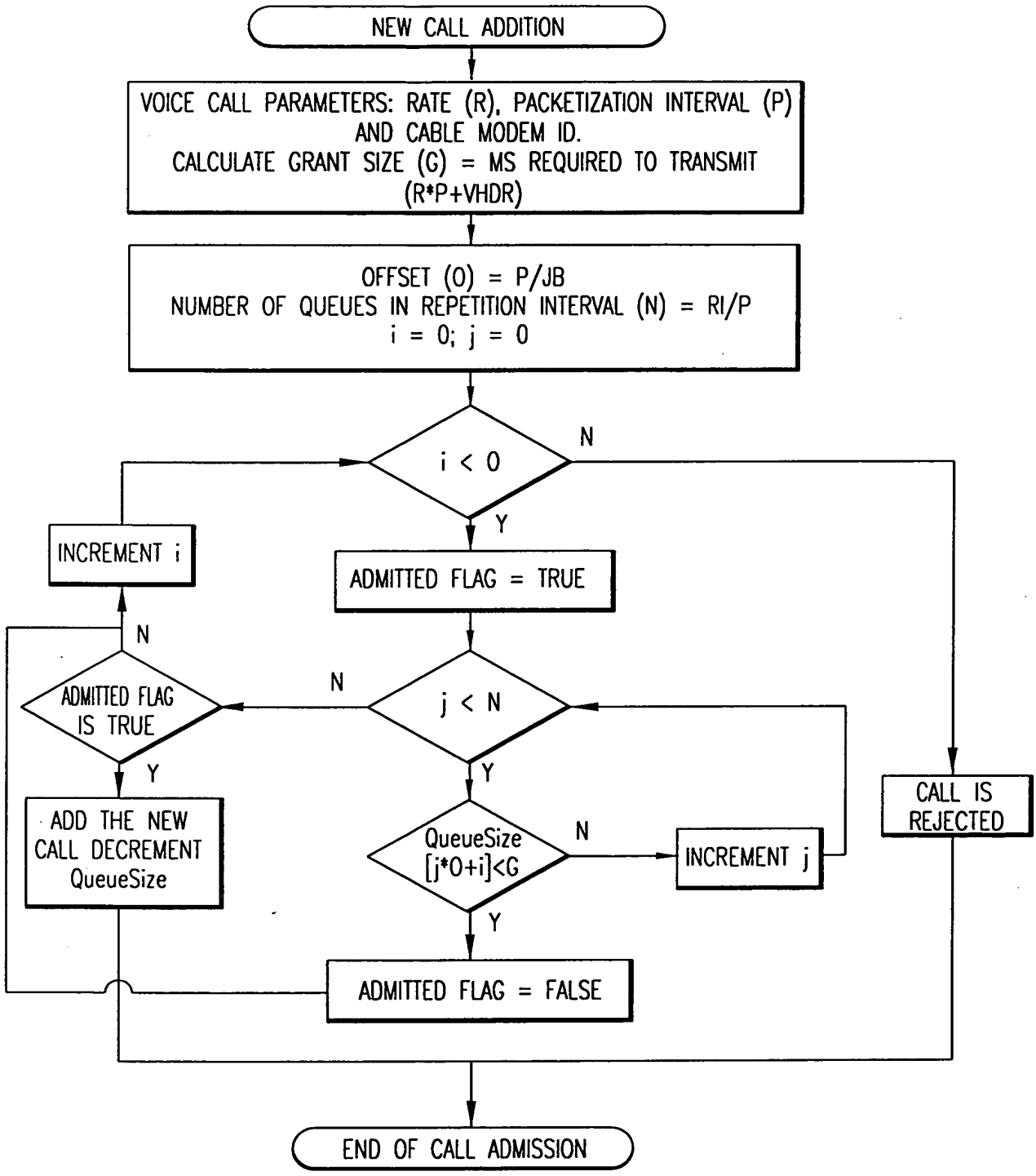

NEW CALL ADDITION
VOICE CALL PARAMETERS: RATE (R), PACKETIZATION INTERVAL (P) AND CABLE MODEM ID.
CALCULATE GRANT SIZE (G) = MS REQUIRED TO TRANSMIT (R*P+VHDR)
OFFSET (O) = P/JB
NUMBER OF QUEUES IN REPETITION INTERVAL (N) = RI/P
i = 0; j = 0
i < 0
N
Y
INCREMENT i
ADMITTED FLAG = TRUE
N
ADMITTED FLAG IS TRUE
N
j < N
Y
Y
ADD THE NEW CALL DECREMENT QueueSize
QueueSize [j*O+i]<G
N
INCREMENT j
CALL IS REJECTED
Y
ADMITTED FLAG = FALSE
END OF CALL ADMISSION

FIG.8

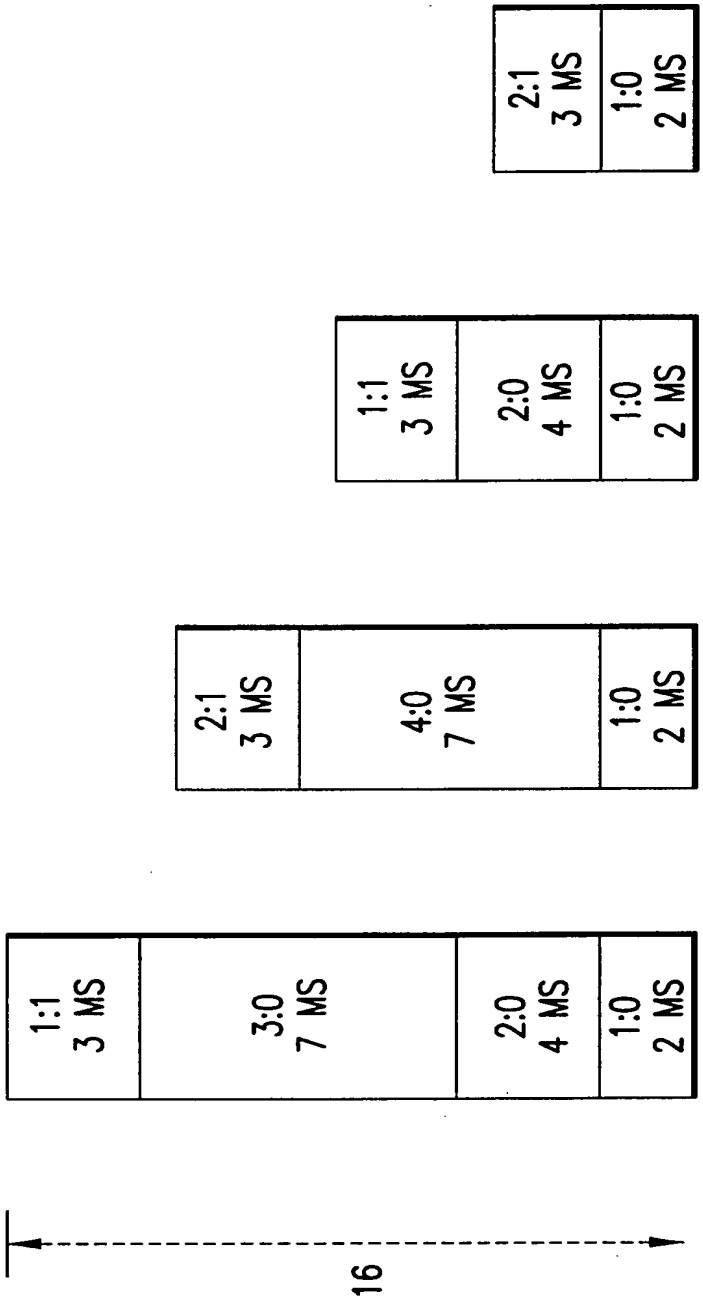

1:1
3 MS
3:0
7 MS
2:0
4 MS
1:0
2 MS
16
2:1
3 MS
4:0
7 MS
1:0
2 MS
1:1
3 MS
2:0
4 MS
1:0
2 MS
2:1
3 MS
1:0
2 MS
CALL ADMISSION: UNBALANCED

FIG.9

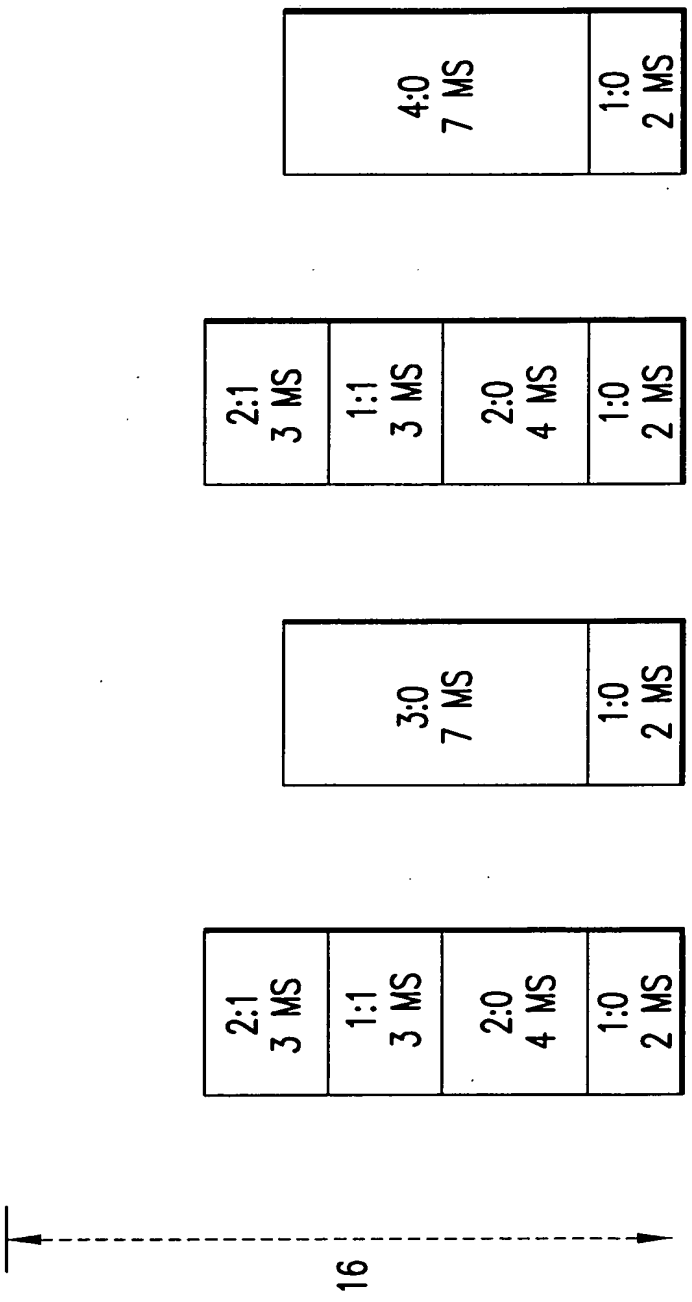
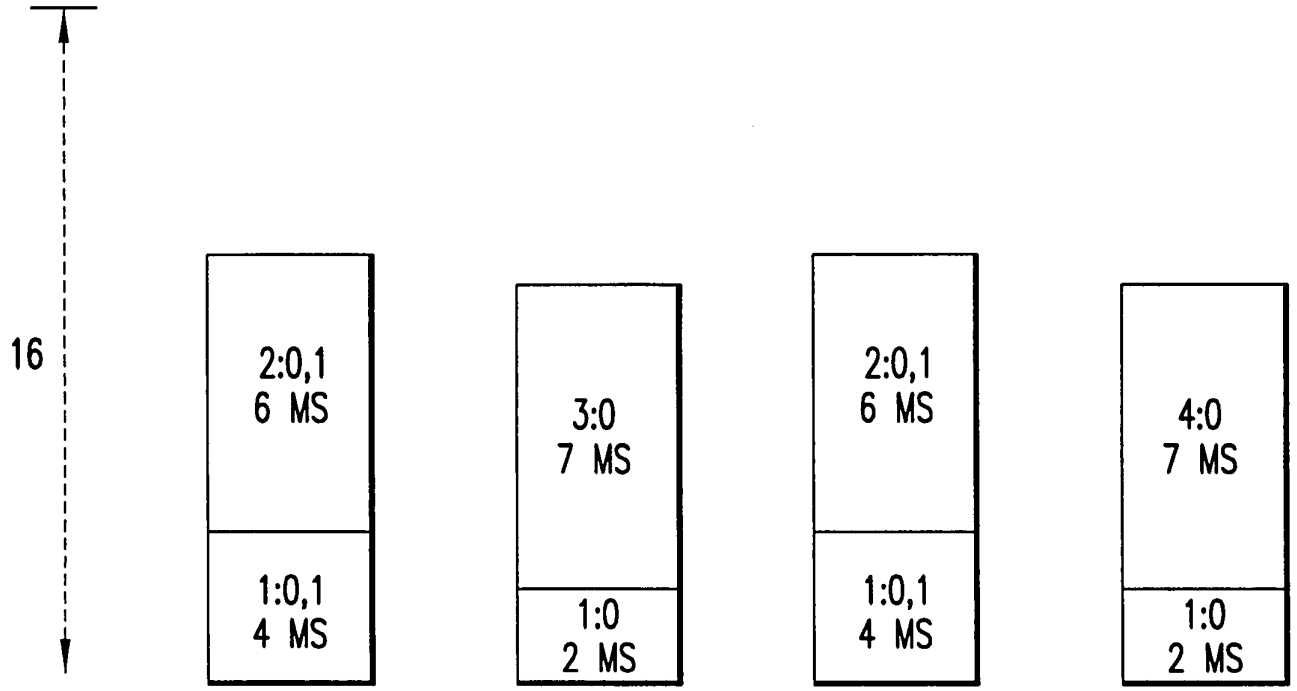
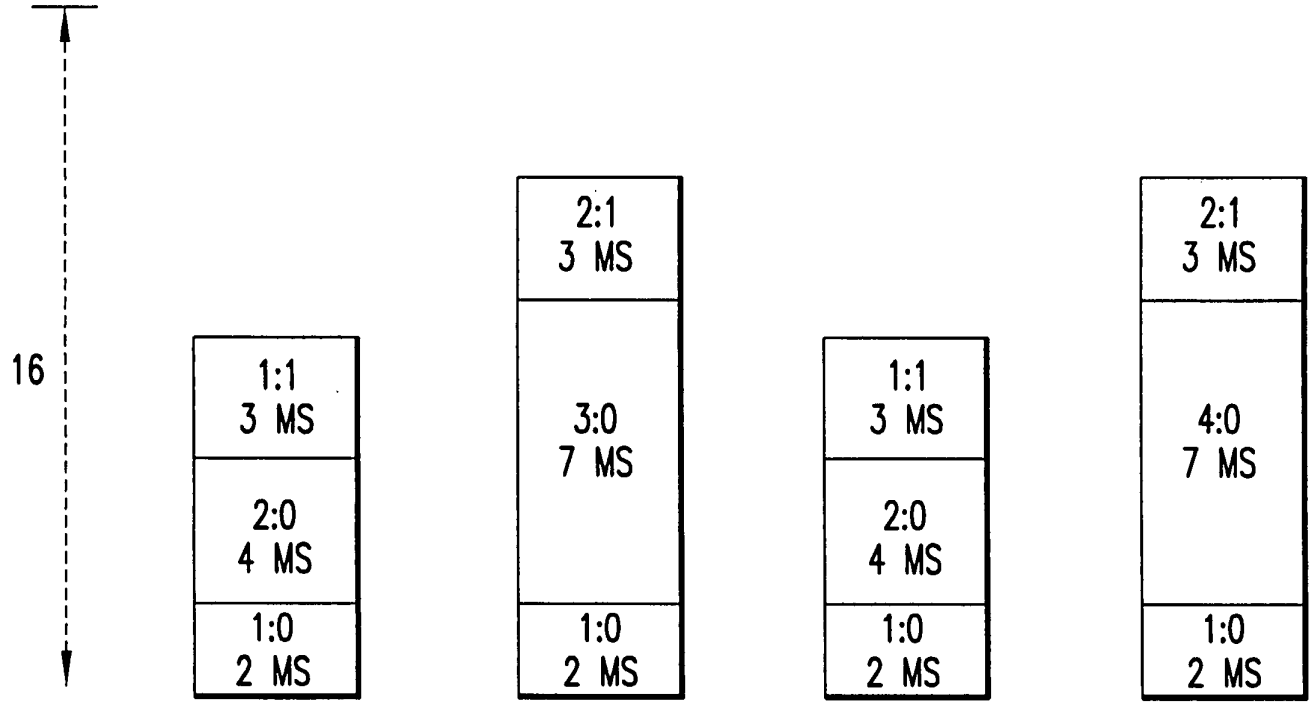

2:1
3 MS
1:1
3 MS
2:0
4 MS
1:0
2 MS
3:0
7 MS
1:0
2 MS
2:1
3 MS
1:1
3 MS
2:0
4 MS
1:0
2 MS
4:0
7 MS
1:0
2 MS
16
CALL ADMISSION: BALANCED

FIG.10



CALL ADMISSION: BALANCED WITH CONCATENATION

FIG.11



CALL ADMISSION: BALANCED AND DISTRIBUTED CM ALLOCATION

FIG.12

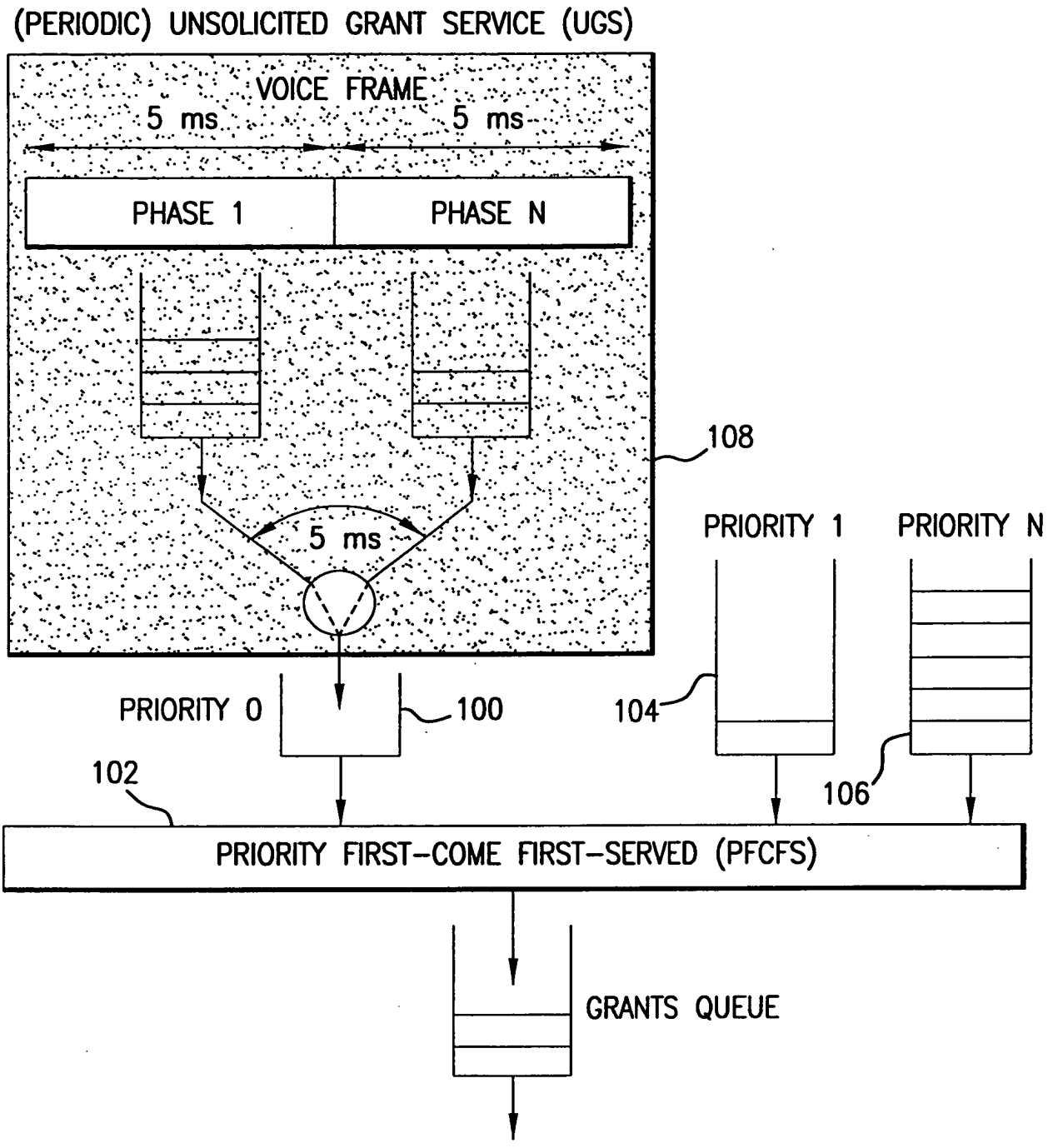

(PERIODIC) UNSOLICITED GRANT SERVICE (UGS)
VOICE FRAME
5 ms
5 ms
PHASE 1
PHASE N
5 ms
108
PRIORITY 1
PRIORITY N
PRIORITY 0
100
104
102
106
PRIORITY FIRST-COME FIRST-SERVED (PFCFS)
GRANTS QUEUE

FIG.13

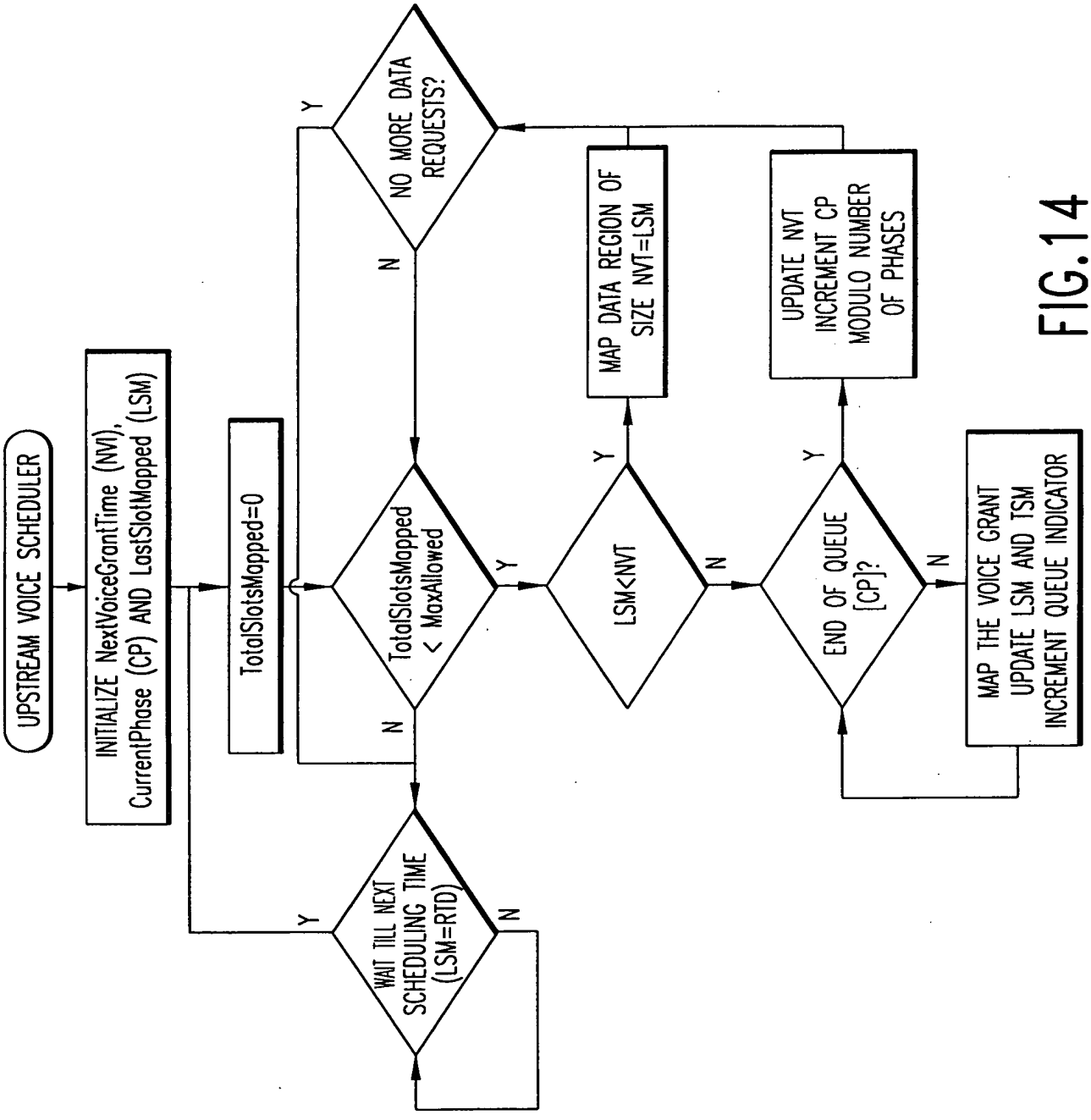

UPSTREAM VOICE SCHEDULER
INITIALIZE NextVoiceGrantTime (NVT), CurrentPhase (CP) AND LastSlotMapped (LSM)
TotalSlotsMapped=0
NO MORE DATA REQUESTS?
Y
N
TotalSlotsMapped < MaxAllowed
Y
N
LSM<NVT
Y
N
END OF QUEUE [CP]?
Y
N
MAP DATA REGION OF SIZE NVT=LSM
UPDATE NVT INCREMENT CP MODULO NUMBER OF PHASES
MAP THE VOICE GRANT UPDATE LSM AND TSM INCREMENT QUEUE INDICATOR
WAIT TILL NEXT SCHEDULING TIME (LSM=RTD)
Y
N

FIG.14

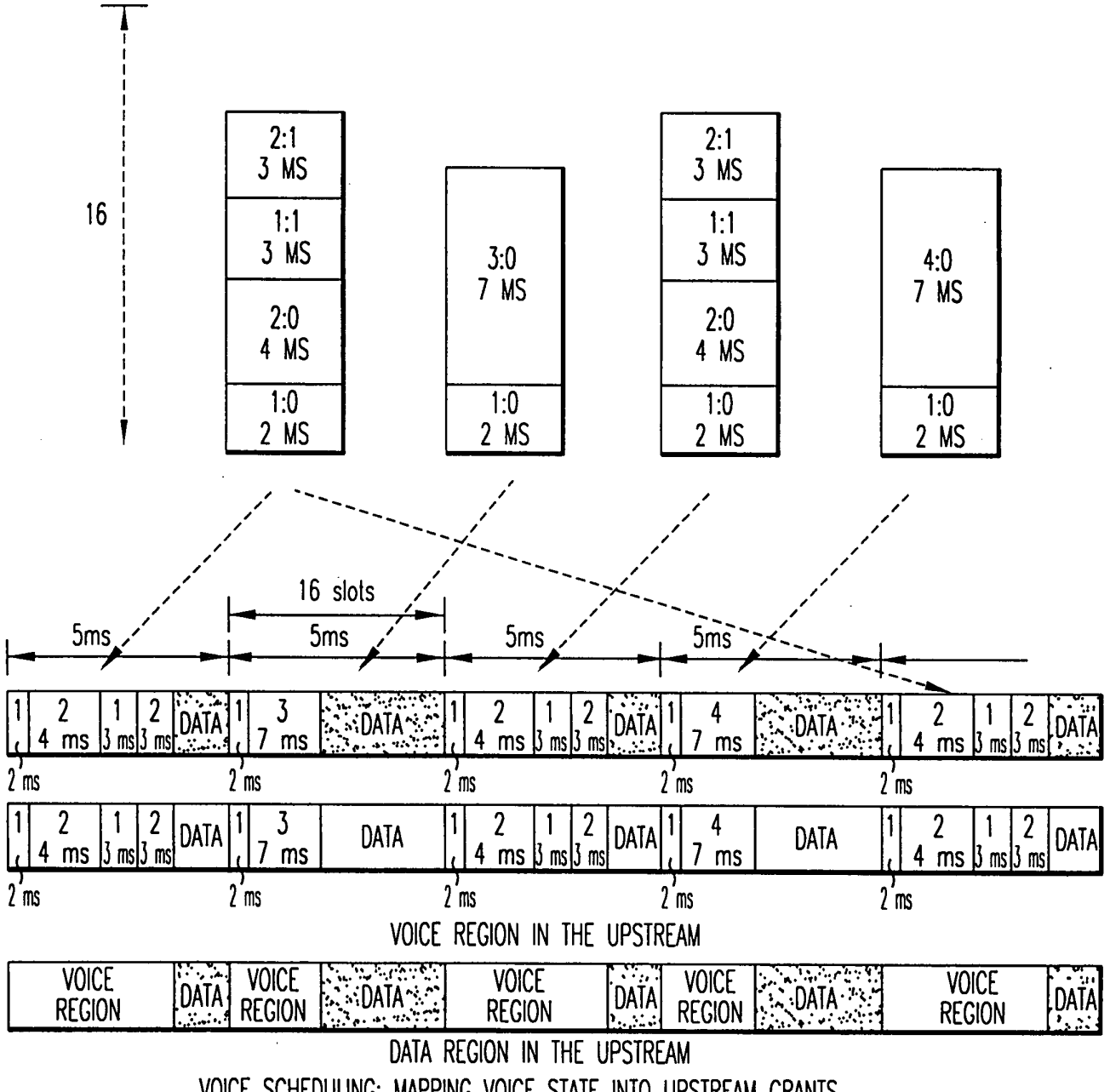
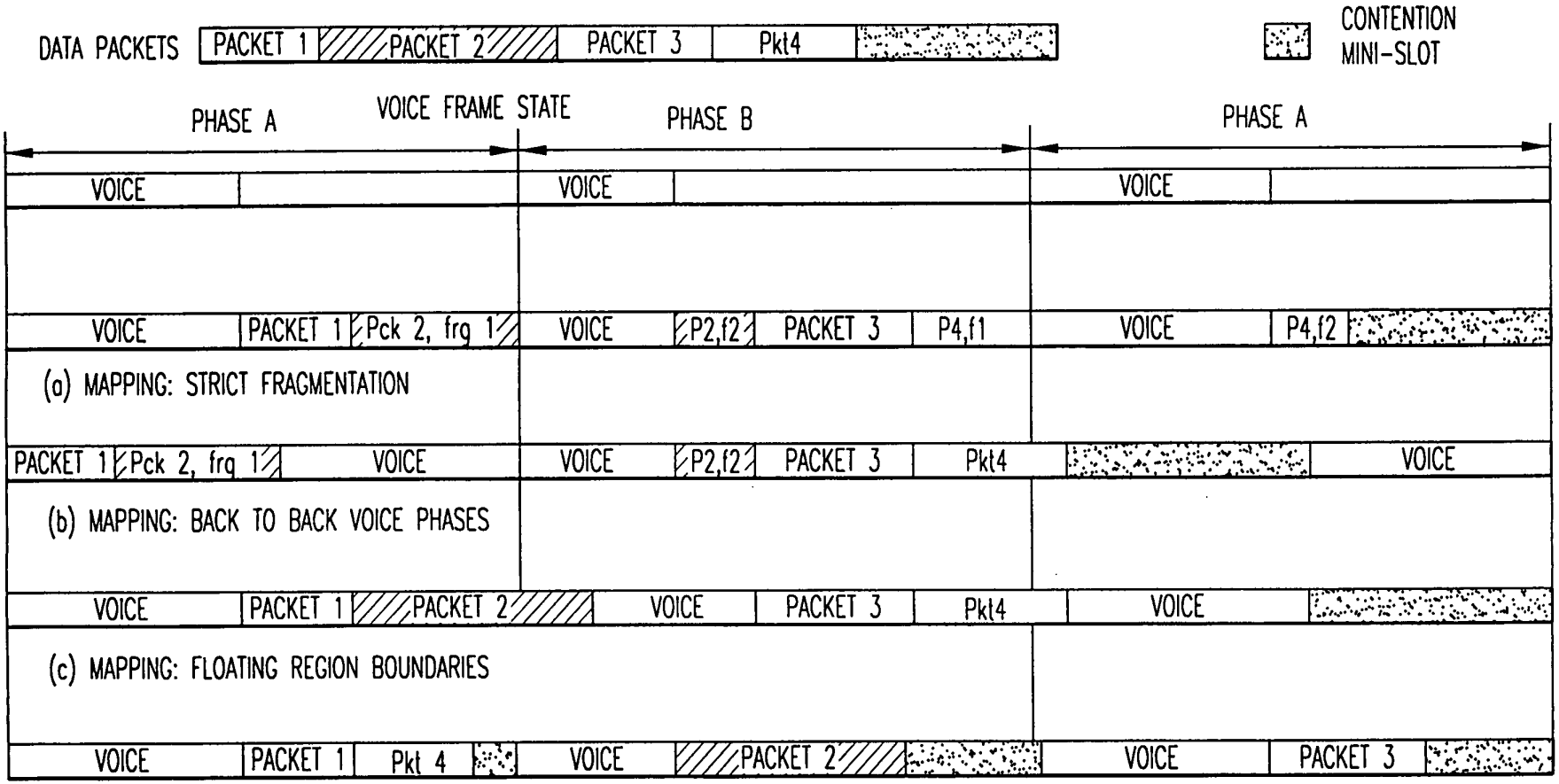


FIG.15

VOICE SCHEDULING: MAPPING VOICE STATE INTO UPSTREAM GRANTS



(d) MAPPING: FIXED REGION BOUNDARIES: BEST FIT (NO FRAGMENTATION)

FIG.16

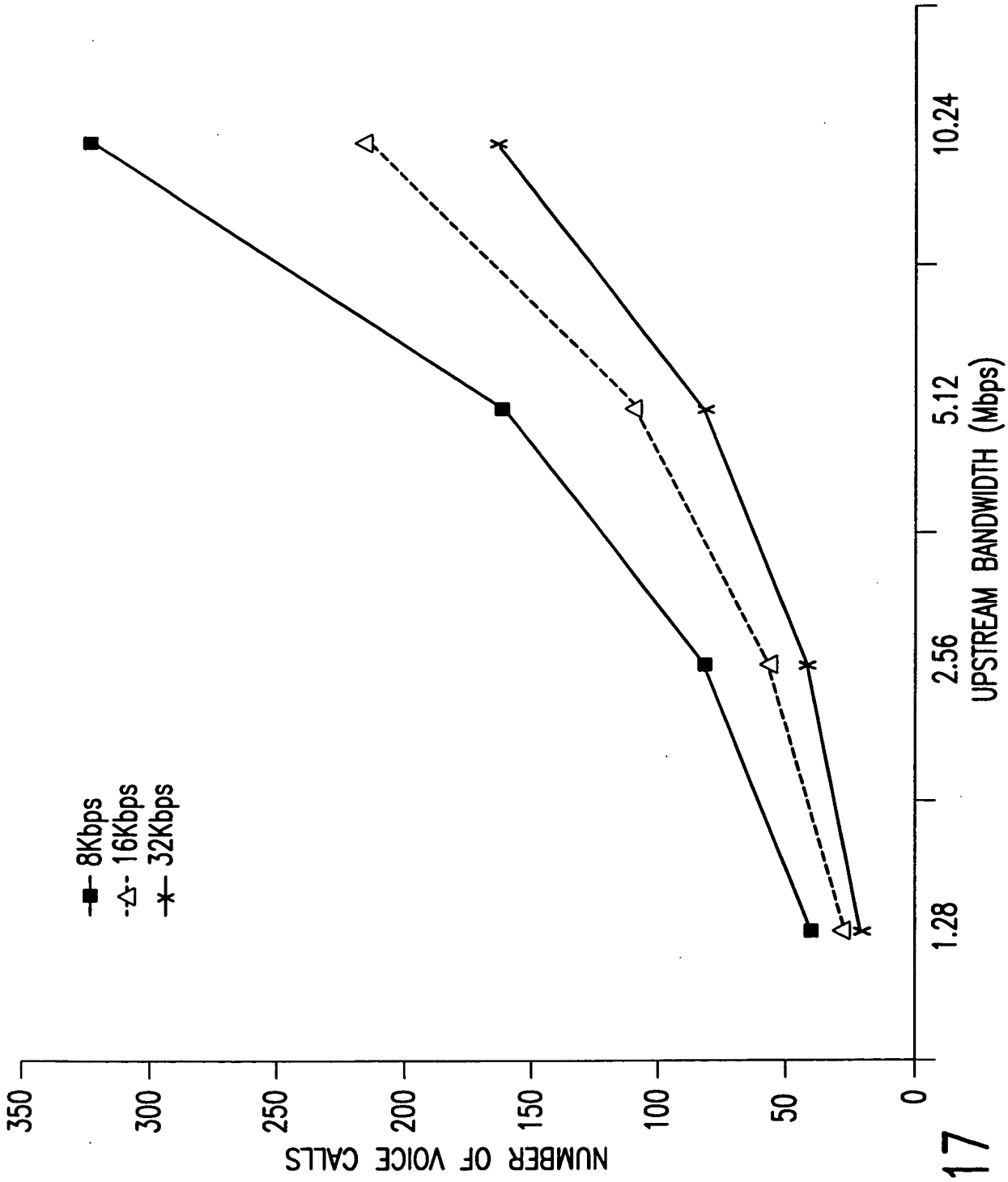

NUMBER OF VOICE CALLS
350
300
250
200
150
100
50
0
1.28
2.56
5.12
10.24
UPSTREAM BANDWIDTH (Mbps)
8Kbps
16Kbps
32Kbps

FIG.17

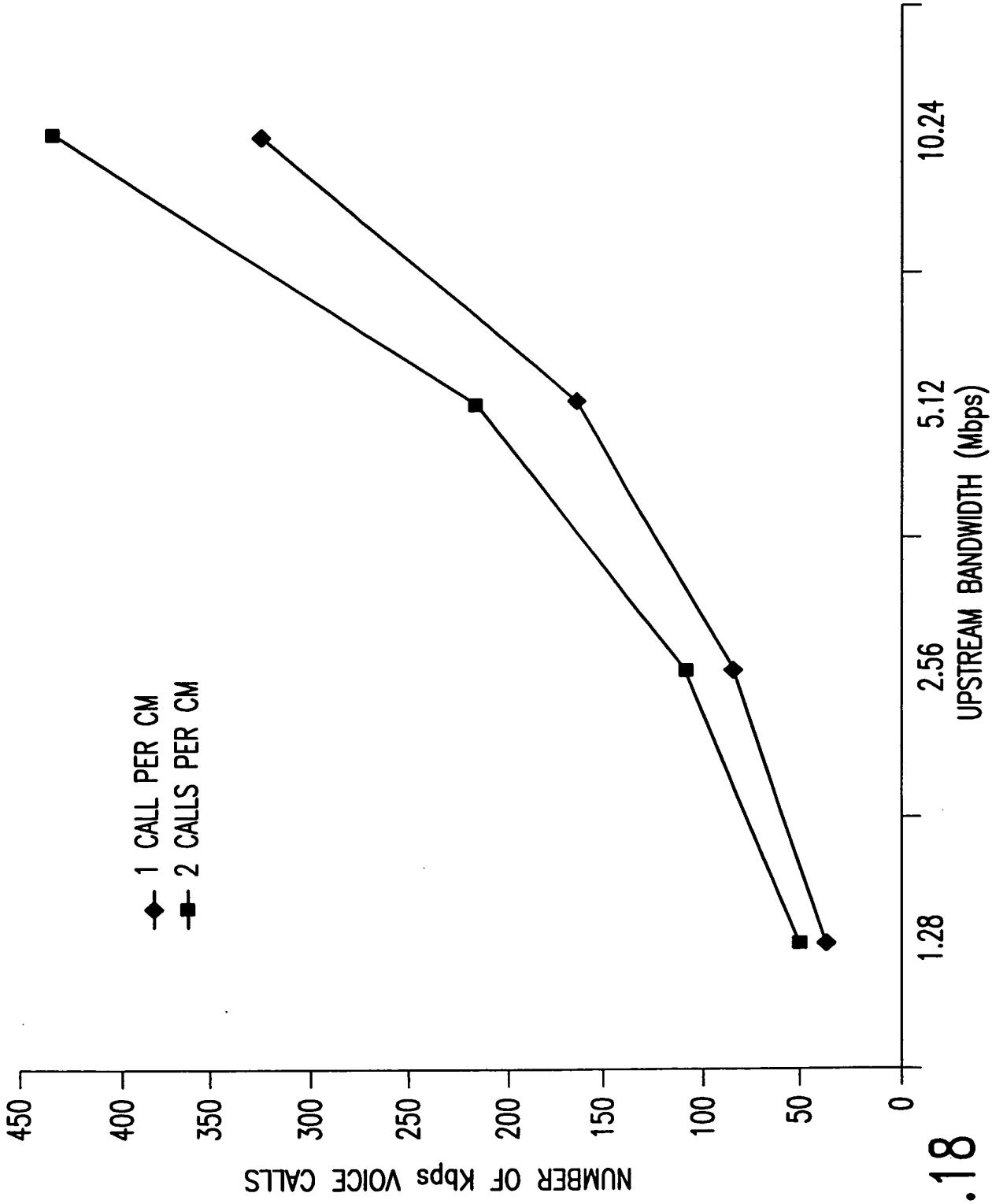

NUMBER OF kbps VOICE CALLS
450
400
350
300
250
200
150
100
50
0
1.28
2.56
5.12
10.24
UPSTREAM BANDWIDTH (Mbps)
1 CALL PER CM
2 CALLS PER CM

FIG.18

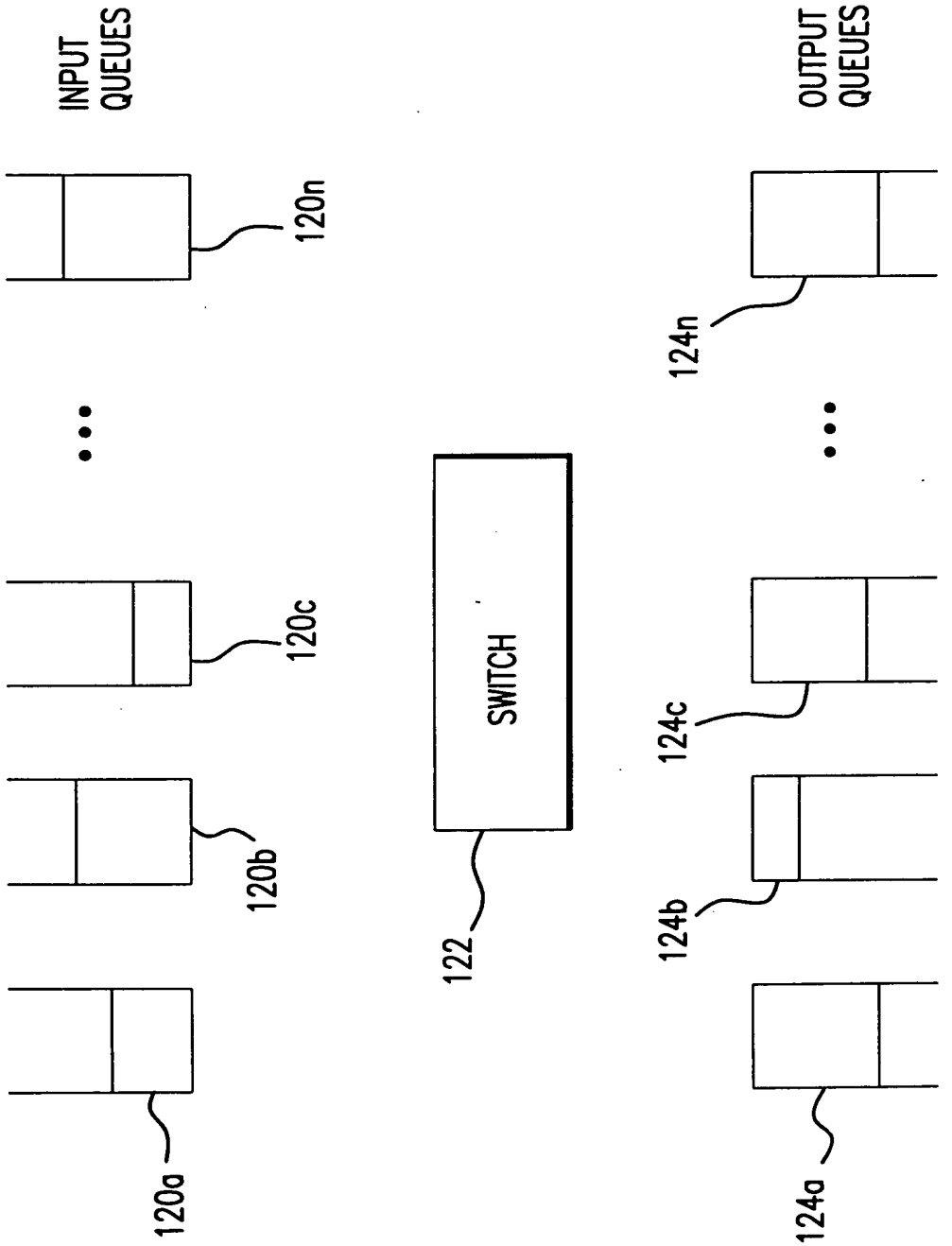

INPUT QUEUES
120n
120c
120b
120a
SWITCH
122
OUTPUT QUEUES
124n
124c
124b
124a

FIG.19